Exploratory Grand Banks Scallop Survey - 1982

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by

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PREFACE

This study resulted from the submission of a proposal to the Department of Supply and Services. Funding to carry out the project was provided jointly by that Department and the Department of Fisheries and Oceans. Mr. W.G. Caudle acted as Science Procurement Manager on behalf of DSS while Project Managers for DFO were Gerry Brothers, St. John's and David Lemon, Halifax.

A complete biological analysis and assessment is presently being conducted by DFO staff and will be available shortly.

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TABLE OF CONTENTS

		Page
Preface		ii
Abstract		iv
Introduction		1
Summary		2
1.0	Fishing Operations	4
	1.1 Methodology	4
	1.2 Vessel Itinerary	5
2.0	Potential Scallop Beds	9
	2.1 Significant Areas of Scallop Concentration	9
	2.2 Quality Considerations Concerning the Iceland Scallop	12
3.0	Commercial Potential For A Grand Banks Scallop Fishery.	13
	3.1 Cost - Volume - Profit Analysis	13
References		14
Appendices		15
Acknowledgements		22

ABSTRACT

Rodger, R.W. and N.D. Davis. 1982. Exploratory Grand Banks Scallop Survey - 1982. Can. Ind. Rep. Fish. Aquat. Sci. 137: iv + 29 p

The Canadian offshore scallop industry, estimated at $100 million landed value in 1981, is experiencing productivity problems caused by the reduction of traditional fishing grounds, declining catch rates and higher costs. In an effort to alleviate the situation, The Fisheries Development Branch in St. John's and Halifax of the Department of Fisheries and Oceans, in conjunction with the Department of Supply and Services sponsored a survey to explore the Grand Banks of Newfoundland for new scallop beds. The survey parties discovered two areas of Iceland scallops on the central portion of the Grand Banks; however, the actual size of the areas must still be delineated. Other parts of the Grand Banks yielded concentrations of scallop which were relatively minor.

RESUME

Rodger, R.W. et N.D. Davis. 1982. Etude exploratrice des petoncles sur les Grand bancs - 1982. Rapport can. ind. sci. halieut. aquat. 137: iv + 29 p

L'industrie hauturière canadienne du pétoncle, dont les débarquements de 1981 sont estimés à $100,000,000, connaît actuellement une période de productivité difficile du fait de la diminution des aires de pêche traditionelle, de taux de prises décroissant et de coûts plus élevés, afin de soulager cette situation, la Direction du développement des pêches de Saint-John's et d'Halifax, du ministère des Pêches et des Oceans, en collaboration avec le ministère des Approvisionnements et Services, a commandité une étude exploratoire des nouveaux gisements de pétoncles sur les Grands bancs de Terre-Neuve. Les équipes d'études ont ainsi découvert deux zones de pétoncles d'Islande dans la partie centrale des Grand bancs; cependant, la dimension courante de ces zones doit être encore mieux definies. D'autres parties des Grand bancs soutiennent, par ailleurs, des concentrations de pétoncles qui sont relativement moins importantes.

Introduction

The giant scallop (Placopecten magellanicus) industry is the most valuable fishery in the Maritime region of Canada, estimated at $100,000,000.00 (one hundred million dollars) in 1981. (Fisheries Statistics Branch, Fisheries and Oceans, Canada). Since the offshore scallop fleet is experiencing difficulty in maintaining seasonable levels of landings from Georges Bank, the scallop industry is eager to find new commercial grounds.

The Iceland scallop (Chlamys islandica) supports an inshore fishery in the Northeastern Gulf of St. Lawrence and is known to be distributed on the Grand Banks of Newfoundland. (Dickie and Chaisson 1955). The general purpose of this study was to conduct an exploratory survey on the Grand Banks (NAFO division 3L, 3N and 30) to determine the distribution and abundance of Iceland scallops, and specifically, to delineate concentrations of scallops.

To conduct the survey, two commercial scallop draggers from the Georges Bank fleet were chartered during July and August 1982. The M.V. Charlotte Louise is a 116-foot wooden vessel skippered by Allen Skinner; during the survey the crew numbered thirteen. (The normal fishing contingent is seventeen). The M.V. Charlotte and Ricky is a 110-foot vessel skippered by Paul Allen; with the same crew complement as the other vessel. These vessels were selected because of the vast experience in scallop fishing held by both masters, and their keen interest in finding a new resource. Both vessels were equipped for dragging either one or two offshore 'New Bedford' scallop rakes.

Although 15-foot rakes are normally used by these vessels during commercial fishing, 13-foot rakes were used throughout this study, because the smaller rake was considered as a base-line size which any vessel in the fleet could tow.

These rakes consisted of 3" metal rings interconnected variously with 2, 3 or 4 links during different periods of the study. Both vessels were equipped with navigational gear including Loran-C and Decca receivers, Loran-C and satellite receiver-computers, radar, depth sounders, single side band and VHF radios. (See Appendix C for further vessel detail).

The areas explored during the survey were the middle portion of division 3L from 46° to 48° N Lat. and areas of 3N including the center of the bank, Southeast Shoal, Lilly Canyon and the Tail of the Bank. In addition, division 30 was explored in the areas of Whale Bank and Whale Deep with some fishing on the western portion of Green Bank. In order to determine selectivity characteristics of the rakes employed, tows were made in 3PS on St. Pierre Bank during the initial and final stages of the survey.

Two types of observations were recorded with set details and biological information. Set details comprised positioning and fishing effort information. The biological data recorded included catch weights and shell heights. As well, shell aging samples, and shell-height meat-weight samples were collected. The catch was exclusively Iceland scallops on all areas of the Grand Banks, while giant scallops did occur on St. Pierre Bank either in discrete beds, or mixed with Iceland scallops. Productive tows were defined as equal to, or greater than, 50 pounds (round weight)/rake-mile. Fifty pounds is approximately the weight of one bushel of scallops. One group of productive tows occurred approximately 25 miles east of the Virgin Rocks in division 3L in 38 to 40 fathoms of water, averaging 114 pounds (round weight)/rake-mile. (See Figure 1).

In general, Iceland scallops were present on the Grand Banks in relatively small quantity, i.e. less than 10 pounds (round weight)/rake-mile. Catches were usually made at depths from 30 to 50 fathoms. Areas of shallower depth were not extensively sampled and depths greater than 50 fathoms yielded even lower catches.

Iceland scallops were caught on both rock and sand substratum. There were two areas found to have substantially larger catches, ranging from 50 to 360 pounds (round weight)/rake-mile. Additional tows were made in an attempt to determine the size of the concentration.

Another area of abundance was found 35 miles south of the Virgin Rocks in division 3N in 36 to 40 fathoms of water, averaging 173 pounds (round weight)/rake-mile.

A cost analysis has been performed to determine the catch levels required to make fishing for scallops on the Grand Banks cost effective. Costs and zero-contribution level (i.e., breakeven level) of catch while fishing Georges Bank were first determined, then applied to a hypothetical season's fishing on the Grand Banks with a Nova Scotia base.

Breakeven was determined to occur at a catch level of 16,110 pounds/trip, which corresponds roughly to 126 pounds (round weight)/rake-mile. * That is, approximately 16,000 pounds of catch are needed to make the fishing operation pay for all expenses of the crew and vessel while at sea. However, this does not cover such shore-based expenses as engineers, tradesmen, office staff, and normal costs associated with land, buildings and equipment.

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* This assumes towing 2 rakes at 4 miles/hour, with the rakes on the bottom 40 minutes of the hour.

Summary

1. Two commercial scallop draggers, the M.V. Charlotte Louise and the M.V. Charlotte and Ricky were chartered for one month to perform an exploratory Iceland scallop survey on the Grand Banks of Newfoundland, July to August 1982.

2. The survey area included NAFO divisions 3L, 3N and 30.

3. The rakes towed during the study were 13-foot "New Bedford" offshore scallop rakes with 2, 3 and 4 link configurations.

4. Selectivity tows were made to estimate scallop retention (percentage), of rakes variously interconnected with 2, 3 and 4 links.

5. Considering the contribution of both vessels, 859 sets were completed, including 511 survey sets and 348 directed fishing sets. The total catch amounted to 25,267 pounds round weight, or 2,552 pounds meat weight (conversion factor - 9.78% (July), 10.22% (Aug.)).

6. Two major areas of Iceland scallop concentration were discovered in the central portion of the Grand Banks. These locations are estimated by the researchers to range in size altogether, somewhere between 200 to 600 square miles in total area. The density of scallop catches varied considerably in these areas.

7. In Area I, two areas of high potential were centered at the following locations:

   i) 49° 50' W 46° 30' N
   ii) 49° 40' W 46° 10' N

   Twenty-eight sets were made in this general area which averaged approximately 2¼ bushels per rake, per mile towed.

8. In Area II, north of the Southeast Shoal, an area of scallop with an approximate center located at 50° 20' W, 45° 30' N was discovered. Average catches, based on 26 sets, was 3½ bushels per rake, per mile towed.

9. Minor concentrations of scallop were found at other locations on the Grand Banks. The west central portion of the Bank (near Whale Deep), much of the northern section of the Bank, and areas around the Tail of the Bank were found to be almost wholly absent of scallop.in the locations surveyed.

10. The optimal depth range for catching Iceland scallops in the areas studied was 36 to 40 fathoms.

11. The scallop beds tend to be comprised of older scallops heavily encrusted with barnacles and other epifauna.

12. Many areas of scallop may have been missed in the course of the survey due to the distances involved. Further study on the size and dimensions of areas found is necessary to fully appreciate their commercial significance.

1.0 FISHING OPERATIONS

1.1 Methodology

The survey plan was based on a sampling technique * which was modified to accomodate known or suspected areas of scallops. Approximately half of the (24 hour) day was spent towing at randomly plotted stations. The remaining time was used for directed fishing, where the skipper and observer team deviated from the planned survey route to further assess a promising bed or to try new areas.

Each occasion that one or both scallop rakes were fished constituted a survey set or tow number. ** Thus a survey set could either be done on "station" (i.e., on the survey plan) or during directed fishing. An effort was made to adjust vessel power, speed and time so that survey tows were kept to approximately 1 mile in length. This took some practice and, for various reasons, was not always accomplished.

Sounder paper recordings were also kept for all survey tows. Information on time of tow, direction of tow, sea and wind conditions, etc. was collected for all tows. Tow location was recorded from the best readings that could be obtained from Loran-C, Decca or Satnav receivers; or from a combination of the above if conditions necessitated.

The set duration was the elapsed time starting when the rake dug into the sea bottom (maximum warp) until the winch began winding the warp back onto the spool. After the rake was hauled back, the contents were emptied and any scallop catch was immediately sorted out. When the total catch was small (under a bushel), the shell height of all scallops was taken at all survey stations. When the catch was larger, it was often impossible to measure each animal before the next tow, so only a sample of the catch was selected for size measurements.

Weight measurements were taken on all scallop catches. When catches were small, actual weight was recorded. On larger catches there was only time to record the number of bushels caught. Trial measurements indicated that a weight of 48 lbs. to the bushel (round weight) was an acceptable conversion factor. No allowance was made for barnacles or other crustaceans on the scallop however, as this weight varied from place to place.

In addition to weighing and measuring the total catch (either directly, or through sampling procedures) records were also kept on the by-catch. Locations of crab, clam, sand dollars, starfish, sea cucumbers, etc. were noted as well as any comments that would further explain the catch results of the towing operation.

The data on each tow, for both vessels, is recorded in Appendix D. Appendix D, because of size, has been printed separately and can be obtained from the Department of Fisheries and Oceans at the address shown on the title page.

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* random stratified sampling (for further information see reference section).

** usually, it was only necessary to use one rake, thus reducing the chances of damage or loss of both rakes over the survey period.

In addition to the above, approximately 200 independent biological samples were obtained for laboratory analysis at the Department of Fisheries and Oceans, St. John's, Newfoundland. These samples were selected according to a very precise procedure in which 5 sample animals were chosen at a time (i.e., twenty altogether) to represent the range of sizes caught in a given scallop area. The adductor muscle was carefully shucked, ensuring that pieces of meat were not left on either shell. These meats were then frozen individually with information tags, for laboratory weight determination by Fisheries Research Branch personnel.

Survey Tows

Biological information was collected at survey stations so that data based on the random stratified sampling technique could be used to estimate the total scallop population and the total biomass (meat weight) on the Grand Banks. Thus, measurements on survey tows were carefully recorded, as were the biological data to accompany meat samples sent to St. John's for analysis. For example, careful attention was paid to the start and end of tow positions, tow distance, catch size and weight on survey station tows.

Directed Fishing Tows

In comparison to survey tows, fishing trials (directed fishing by captain and observer teams) were to explore new areas not planned on the survey, or to make additional tows in areas of abundance to determine the size of a bed. Since this data would not be further analysed, complete profiles were not recorded,(start, end and mean depth were recorded however) and towing distances were more variable, depending on the skipper's intuition.

As the survey progressed, it became apparent that directed fishing tows would not be productive in some areas (for example; if the water was too deep, or nearby areas had already been surveyed) so that directed fishing time was accumulated,as the survey stations were completed earlier than expected. This provided additional time to survey areas where scallops were found, and also to survey parts of the Southeast Shoal and The Tail of The Bank.

While many extra fishing trials were made in areas where scallop concentrations were found, it should be noted that overall, very little time was available for the vessels to stay in any one area. The survey route(s) covered a large portion of the Grand Banks and it was necessary to push on and finish the survey even when large catches of scallop were encountered in some areas. For this reason, the total scallop catch for the trip was lower than it might have been had the vessels maintained a fishing effort in more productive areas.

1.0 FISHING OPERATIONS

1.2 Vessel Itinerary

The M.V. Charlotte Louise and the M.V. Charlotte and Ricky departed Lunenburg, Nova Scotia on July 17, 1982. The two boats proceeded to Louisbourg together to pick up additional fuel. The M.V. Charlotte Louise continued on to the Grand Banks to commence the survey on July 19, while the M.V. Charlotte and Ricky stopped on St. Pierre Bank to make several selectivity tows. Figure 1 outlines the vessels' concise tracks.

On July 21, the M.V. Charlotte and Ricky commenced towing at survey stations in division 3L. These stations were in depth strata of 30 to 100 fathoms. After finishing the required survey sets the M.V. Charlotte and Ricky came into St. St. John's, Newfoundland on July 28, a few days earlier than expected due to failure of the auxiliary engine. The M.V. Charlotte Louise joined the other dragger in St. John's on July 30.

After the first phase of the trip was evaluated, a decision was made to cancel the remaining sets planned for sub area 3L because of poor catches.

A plan was then prepared which concentrated on sub areas 3N and 30 for the second phase of the project.

These positions were selected in consultation with the captains regarding locations where they thought scallops would be found and where the type of bottom seemed likely to produce scallop catches. The optimal depth chosen for fishing scallops was determined at 30 to 50 fathoms.

The vessels departed St. John's together on August 1, and resumed fishing operations within 12 hours of departure. The M.V. Charlotte Louise completed the survey on August 13, steamed to St. Pierre Bank where a few hours of fishing tows were made, and proceeded on to Lunenburg where it arrived on August 15.

The M.V. Charlotte and Ricky steamed back to St. John's on August 7, resumed fishing by August 11, and completed all stations by August 13. Additional fishing was conducted on Green Bank and several selectivity tows on St. Pierre Bank were also completed. The vessel made port in Lunenburg on August 18.

The total number of sets completed by both vessels was 859 (Table 1). The number of survey stations successfully completed by both vessels was 496, not including inverted rakes or repeated stations. * The number of fishing trials represents the number of directed trials which were completed. The total catch is the sum of the total (pounds round weight) from Appendix D. In tows where the catch was less than 2 pounds, 1 pound was used to compute the contribution of that tow towards the total catch.

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* A 'set' refers to an individual towing trial using either one or two rakes while a 'station' refers to a towing area where one or more sets may be made.

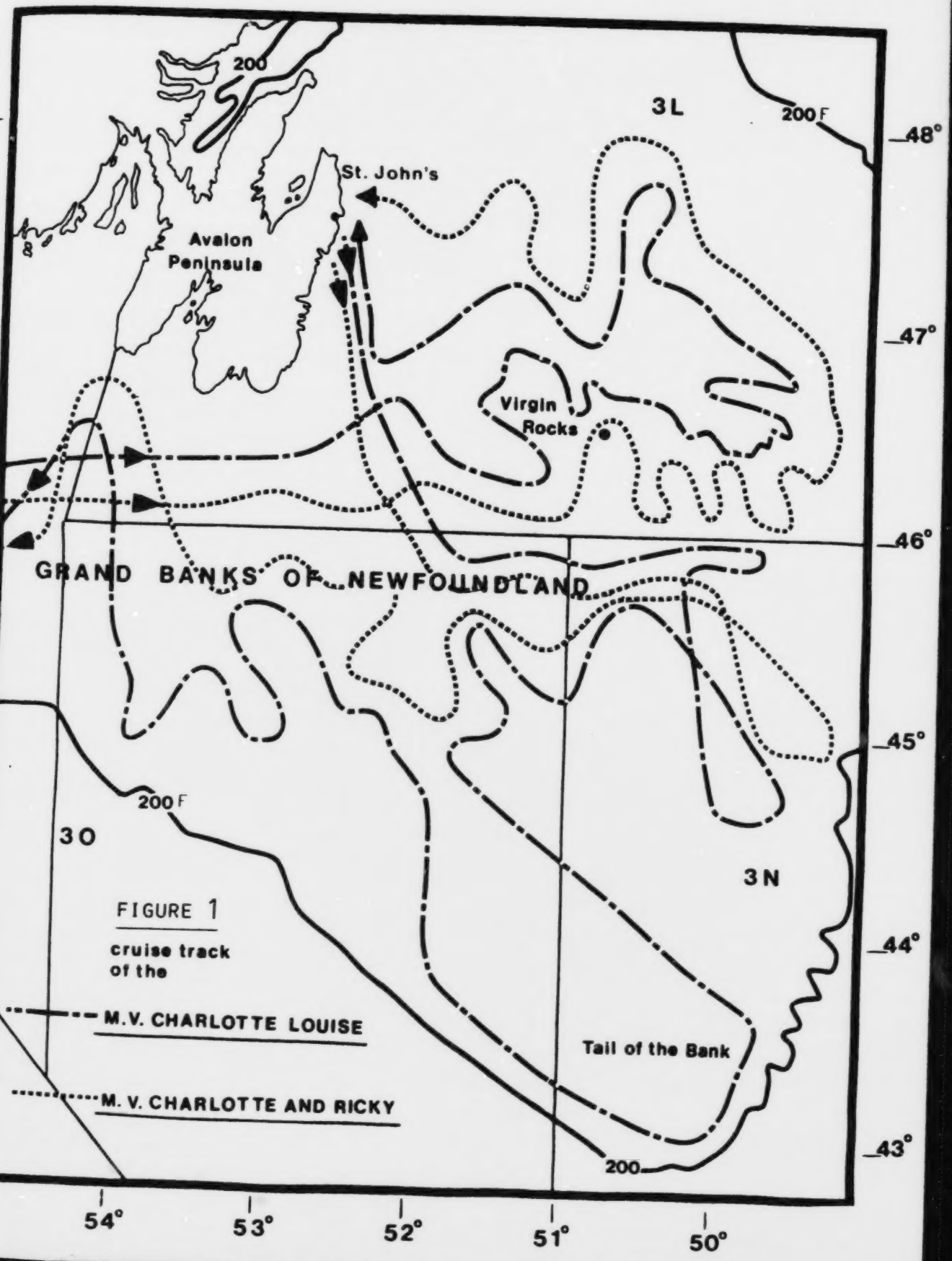

FIGURE 1

cruise track of the

TABLE 1

Sets completed and Iceland scallop catch for the M.V. Charlotte Louise and the M.V. Charlotte and Ricky July 17 to August 18, 1982 on the Grand Banks of Newfoundland.

	# of sets	# of survey sets	# of fishing trial sets	catch round wt. (pounds)	Meat wt. (pounds) *
M.V. Charlotte Louise	526	250	276	18,116	1,822
M.V. Charlotte and Ricky	333	261	72	7,151	730 **
	859	511	348	25,267	2,552

* factors used to convert round weight to meat weight are 9.78 (July) and 10.22 (August), (Naidu 1982).

Note: Since considerable marine growth was found on shells on the Grand Banks in comparison to that found on the Strait of Belle Isle, this conversion factor may overstate actual meat weights.

** M.V. Charlotte and Ricky landed an additional 1,958 pounds (round weight) while conducting selectivity trials on St. Pierre Bank.

2.0 POTENTIAL SCALLOP BEDS

2.1 Significant Areas of Scallop Concentration

Each area encountered on the survey where scallop catches were greater than 50 pounds (round weight)/rake-mile is represented in Figure 2. (This represents a catch of 1 bushel of scallops, in each rake, for every mile towed). All catches were of the Iceland scallop variety. Only a few dead sea scallop shells were found on the Grand Banks. These were presumed to have washed out in the tide from coastal areas, or to have been dropped after shucking, from other vessels.

As represented in Figure 2, there were several areas where catches were greater than 1 bushel/rake-mile (note: illustrated areas are not to scale). Table 2 presents the average weight of the scallop catch per area based on the number of catches over 50 lbs./ rake-mile in that area.

As can be noticed in the diagram, there appears to be a concentration of high catches in the areas labelled Area I and Area II. Area I was actually found to be composed of two smaller beds which tended to overlap each other. The largest catch of the trip, approximately 7 bushels per rake; was recorded in the northern section of Area I at 49° 57' W and 46° 28' N. This concentration of scallop carries eastward (90° magnetic) over a distance of about 10 miles. However, this scallop area has not been fully determined.

About 5 miles directly south (180° magnetic) of this scallop concentration, another concentration of scallop was encountered in the same area, which seemed to extend a distance of at least 20 miles further south. In between the north and south concentrations in Area I very few scallops were discovered in this survey; however, only a few trials were made. Scallop in Area I (both concentrations) were often noted to be found in pockets, rather that in a continuous population. Scallops in the southern section of Area I also appeared to be in less dense groupings than in the northern section.

Overall, 28 sets were made in this area with an average catch of 114 pounds of scallop/rake-mile (i.e., about 2¼ bushels/ rake).

In comparison to Area I, Area II seemed to have a relatively consistent concentration of scallop catch; starting from 50° 30' W/45° 22' N and running in a north-easterly direction (50° magnetic) over a distance of approximately 20 miles. This scallop area is believed to be at least 10 miles in depth through part of its length. While the full extent of the area has not been determined, 26 sets at this location produced average catches of 173 lbs./ rake-mile (i.e., about 3½ bushels for each rake, per mile towed). See Appendix A for further description of findings.

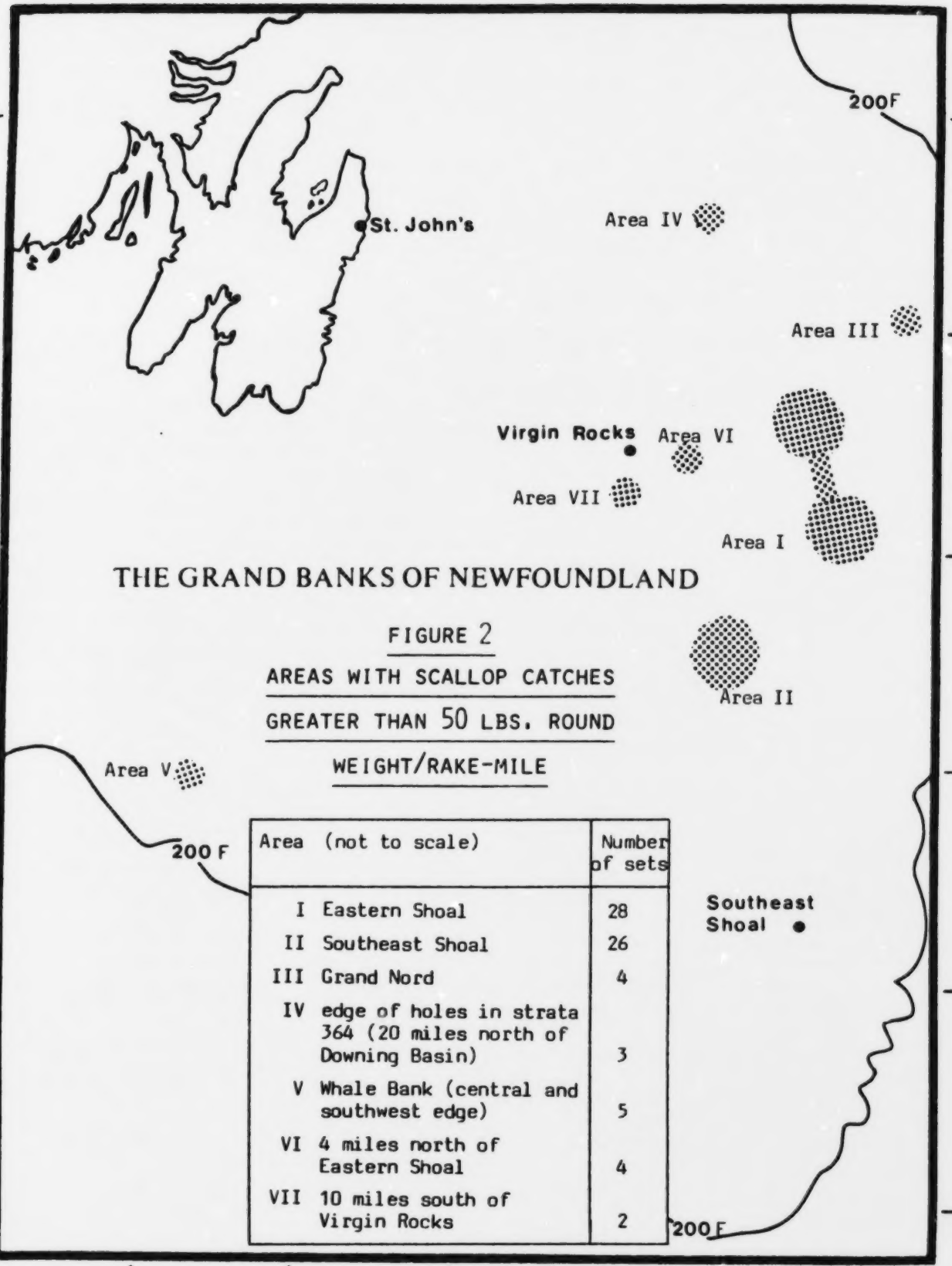

FIGURE 2

AREAS WITH SCALLOP CATCHES GREATER THAN 50 LBS. ROUND WEIGHT/RAKE-MILE

Area (not to scale)		Number of sets
I	Eastern Shoal	28
II	Southeast Shoal	26
III	Grand Nord	4
IV	edge of holes in strata 364 (20 miles north of Downing Basin)	3
V	Whale Bank (central and southwest edge)	5
VI	4 miles north of Eastern Shoal	4
VII	10 miles south of Virgin Rocks	2

TABLE 2

Concentration greater than 50 pound (round weight)/rake-mile of Iceland scallops caught in relation to frequency of sets, catches and depth of water.

Area	Number of sets	Total Catch lbs. (round wt.) per rake mile	Avg. Catch lbs. (round wt.) per rake mile	Average Depth fathoms
Eastern Shoal	28	3,201	114	38
Southeast Shoal	26	4,493	173	40
Grand Nord	4	408	102	48
edge of holes in strata 364 (20 miles north of Downing Basin)	3	399	133	61
Whale Bank (central and southwest edge)	5	364	73	42
4 miles north of Eastern Shoal	4	342	86	45
10 miles south of Virgin Rocks	2	188	94	45

2.0 POTENTIAL SCALLOP BEDS

2.2 Quality Considerations Concerning the Iceland Scallop

The quality of Iceland scallops landed during the survey varied according to three main factors:

1) meat size
2) firmness and texture of the meats, and
3) the amount and type of growth on the shells (eg. barnacles).

Iceland scallops were found to vary in meat counts (per pound) from about 30 (on St. Pierre Bank) to 80 or more in other locations. Some areas of catch seemed to have older scallops as evidenced by the number of barnacles and other growths on the outer shells. These barnacle-ridden scallops frequently yielded soft, stringy meats. In some cases meats were almost jelly-like and had to be thrown out. Brothers (1976) noted similarly encrusted scallops with soft, stringy meats along the Labrador coast.

In other survey areas scallops encountered were clean-shelled and appeared very healthy, with meat counts often in the 40 - 50 range. The size, firmness and texture of the meats from clean-shelled scallops was preferable, on the whole, to meat from scallops with barnacles or other crustacean growth on the shell.

Healthier scallops are believed by the researchers to be more frequently found around the outer edges of scallop concentrations.

The central areas of potential scallop beds appeared to consist of scallops which were older and in more general decay. However, since barnacle-ridden scallops were usually small, and also since few dead shells were found in the middle of scallop concentrations, it has also been suggested that poor feed may be contributing to the lack of quality in the meats. Thus meat quality may be dependent on both age and feed factors.

Captain Allen and Captain Skinner were both of the opinion that repeated dragging of the scallop areas would "stir up the feed" and probably contribute to healthier scallops. Indeed, it was pointed out that on St. Pierre Bank, Iceland scallop quality appears to have improved greatly over the years since they were first fished. Vessels returning to St. Pierre Bank after a 8 or 10 year absence described the quality of catch as excellent, with meat counts often in the 30 range. Squires (1962) has noted that beds tended to be improved by occasional fishing to remove old scallops. Thus, it is suggested that future fishing efforts will improve the meat qualities of the scallop areas presently discovered on the Grand Banks.

The taste and flavour of Iceland scallops appears to be comparable with the sea scallop and visually it is difficult, if not impossible to tell them apart. Occasionally, Iceland scallops on The Grand Banks were noticed to have a slightly pinkish colouring, and may have been sweeter to the taste, than sea scallops. Iceland scallops did not seem to store as well on ice as sea scallops; however, this observation requires further confirmation.

3.0 COMMERCIAL POTENTIAL FOR A GRAND BANKS SCALLOP FISHERY

3.1 Cost - Volume - Profit Analysis

Several assumptions have been made in this analysis. The Eastern Canadian offshore scallop fleet was assumed to be based in Nova Scotia, although this might not be the case for a Grand Banks fishery. Basing the present fleet in Newfoundland would produce a greater gross profit margin, but the arrangements made between the owner and the ship's company would produce other expenses (eg. travel) which could only be approximated in this study.

Additionally, no effort was made to assess the feasibility of a "mixed" (Georges and Grand Banks) fishery. The decision as to when to fish Georges and when to fish the Grand Banks would depend upon the volumes of catch available at each location. (An accurate decision on which Bank to fish could probably be determined if processors utilized cost-volume-profit models for their operations).

The allocation of revenue and expenses from a typical scallop catch is outlined in Table 3. Tables 4 and 5 show the annual direct fishing, vessel and general expenses applicable to the Georges Bank (Table 4) and a Grand Bank (Table 5) fishery. These tables illustrate a vessel's contribution to the costs and expenses of a shore facility.

From the contribution margin, (Table 4),.the owner must pay for running a shore facility (the cost of which will vary according to the operation's size). This includes shore engineers, tradesmen, office staff, and all normal costs associated with land, buildings and equipment, supplies, utilities, etcetera. Depreciation does not enter into the equation due to the age of the current fleet.

The landed value of scallops in Nova Scotia as of Sept. 23, 1982 was $3.80/pound. Capt. Paul Allen has estimated that at this price, the minimum average catch at which a vessel can fish Georges Bank is approximately 12,000 pounds per trip. Based on the calculations presented in Table 3, the contribution margin (Table 4) equals zero at an average catch of 12,295 pounds per trip. See Figure 3 for an illustration of profit and loss at various catch levels.

Captain Allen has suggested that the average number of trips which a Nova Scotian vessel could make to the Grand Banks would decline to 12 from the present 16 trips to Georges Bank. This is due to the three days' extra steaming involved (average time to Central Grand Banks), and climatic differences.

The illustration indicates that zero-contribution for a twelve-trip year fishing the Grand Banks from Southern Nova Scotia will be achieved at a catch level of 16,110 pounds per trip. *

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* For purposes of this analysis zero-contribution can be considered as the breakeven level at which all expenses for ship and crew are paid by fishing revenues.

Zero-contribution is not a desirable situation for a profit-oriented enterprise to be in, especially when the overhead costs involved in running a shore facility have not been considered. Therefore,it is concluded that the minimum average catch level (at present prices and expense levels) in which a Nova Scotia fleet could exploit the Grand Banks would be about 17,000 pounds. Even at this level, strict paring of expenses would be required.

A further consideration is that vessel replacement at zero-contribution would be difficult.

However, zero-contribution level is affected by both the supply of scallop, and the price. If price continues to rise, as it is doing now, then the breakeven catch level will drop. This is likely to happen if markets remain firm, and North American supplies continue to decline, which appears to be the case.

The price of $3.80 appears reasonable as it reflects a relatively average price over the last two years. However, it is quite possible that prices could remain high as supply dwindles. There is no difference in the landed price (per pound) of sea scallops and Iceland scallops in Nova Scotia at the time of writing.

TABLE 3

A TYPICAL ALLOCATION OF REVENUE SCHEME FOR SCALLOP FISHING

GROSS REVENUE

LESS:
- Captain's Commission (5½%)
- First Mate's Commission (1%)
- Chief Engineer's Wages ($15.00/day)
- Fuel and Lubricants
- Ice and Scallop Bags

YIELDS: REVENUE TO BE SPLIT

FISHERMEN'S SHARE 60%	COMPANY'S SHARE 40%
LESS: Provisions Cook's Wages - ($8.00/day) 2nd Engineer's Wages - ($5.00/day)	LESS: Fishing Supplies Maintenance Compensation Insurance Sundry Chief Engineer's Share
YIELDS: Amount divided by the number of crew to give value of one share, the basic deckhand's earnings. The Chief Engineer's share is paid by the owner, and the master receives two shares. Typical crew is fifteen or sixteen. (Throughout the analysis, fifteen crew members are assumed).	YIELDS: Contribution Margin, from which the shore facility operates.

TABLE 4

ASSUMED REVENUE AND TYPICAL CURRENT EXPENSES, GEORGES BANK FROM NOVA SCOTIA (16 TWELVE DAY TRIPS PER ANNUM)

ASSUMED GROSS REVENUE (1)		1,216,000
DIRECT FISHING EXPENSES		
Captain and Crew (2)	656,560	
Ice and Bags	4,750	
Provisions	25,000	
Fuels and Lubricants (3)	190,000	
Fishing Supplies	37,500	
Compensation & Benefits	9,500	
Total Fishing Expenses		923,310
GROSS PROFIT		292,690
VESSEL AND GENERAL EXPENSES		
Repairs and Maintenance (4)	90,000	
Insurance (5)	40,000	
Sundry	5,000	
Total Vessel and General Expenses		135,000
CONTRIBUTION MARGIN (SALES MINUS VARIABLE EXPENSES)		$ 157,690

TABLE 5

ASSUMED REVENUE AND TYPICAL CURRENT EXPENSES, GRAND BANKS FROM NOVA SCOTIA (12 FIFTEEN DAY TRIPS PER ANNUM)

ASSUMED GROSS REVENUE (1)		$ 912,000
DIRECT FISHING EXPENSES		
Captain and Crew (2)	464,010	
Ice and Bags	4,750	
Provisions	23,640	
Fuels and Lubricants (3)	177,900	
Fishing Supplies	37,500	
Compensation	9,500	
Total Fishing Expenses		717,300
GROSS PROFIT		194,700
VESSEL & GENERAL EXPENSES		
Repairs and Maintenance (4)	90,000	
Insurance (5)	40,000	
Sundry	5,000	
Total Vessel and General Expenses		135,000
CONTRIBUTION MARGIN		$ 59,700

NOTES TO TABLES 4 & 5

Typical current expenses for Nova Scotian scallop vessel fishing Georges Bank. *

1. Assumed gross revenue is derived from an average catch of 20,000 pounds at a price of $3.80/pound sea scallops (price as of September 23, 1982). **

2. The actual computation involved is quite complex. It is outlined in Appendix A in the manner in which the vessels chartered are accustomed to performing it. The figure is the total of all shares, commissions and wages.

3. Fuel consumption is taken at a rate of 30 gallons/hour, and priced at the September 23, 1982 rate of $1.42/gallon.

4. This applies to an average steel vessel. Maintaining a wooden vessel is considered to be more expensive by perhaps 15% (or more, depending on the vessel's age).

5. Although it is not strictly a variable expense, insurance has been included in arriving at the contribution margin because it is clearly a vessel expense.

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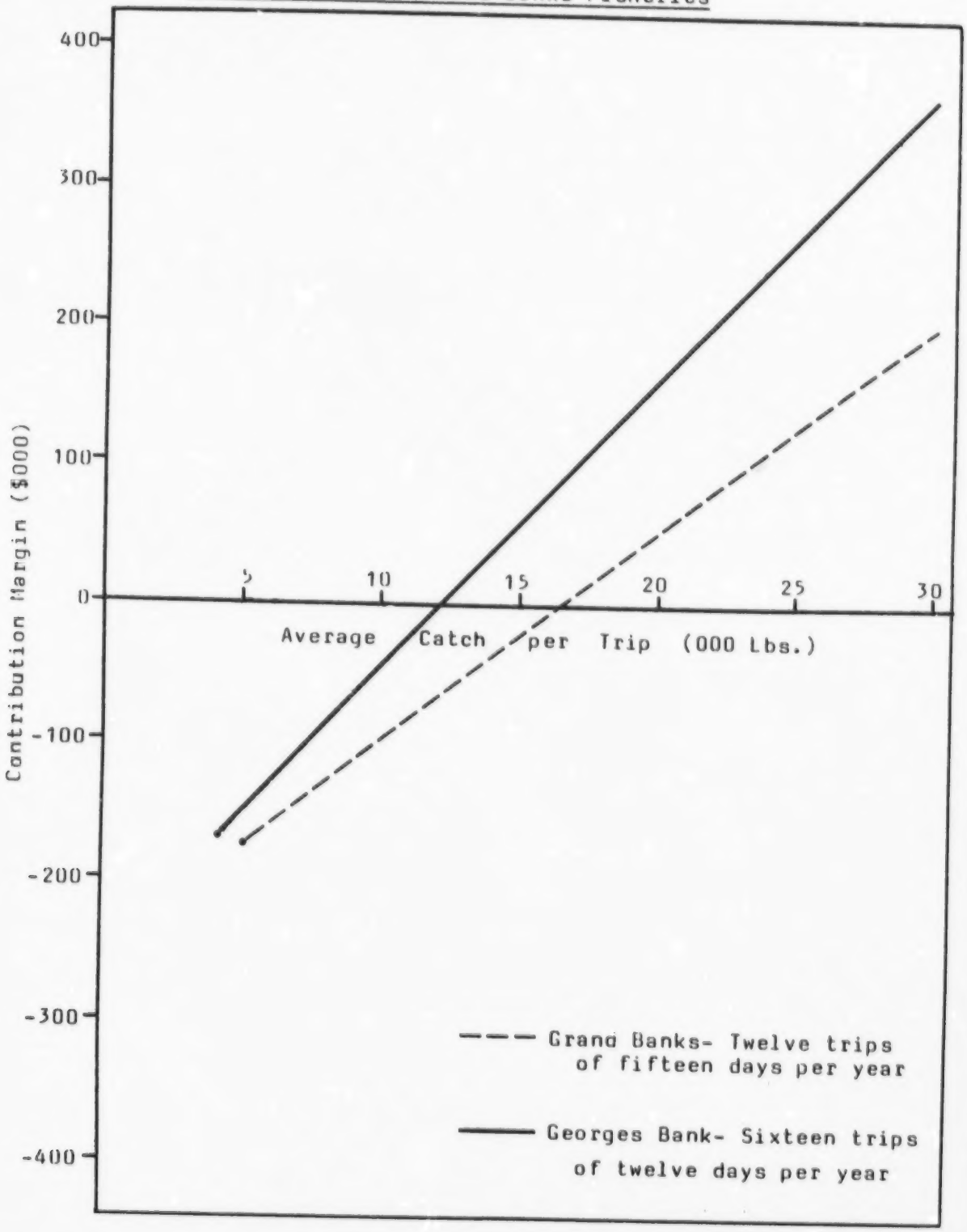
* Adapted from D. Knickle "Feasibility of Replacing the Nova Scotian Offshore Scallop Fleet;, M.B.A. Thesis in Progress, St. Mary's University 1982, with Capt. Paul Allen's corroboration.

** Iceland scallops could market at a lower value.

FIGURE 3

Volume-Contribution Margin Curves for
Georges Bank and Grand Banks Fisheries



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APPENDIX A

OTHER FINDINGS ON THE GRAND BANKS

Several smaller areas were found where scallop concentrations were greater than 50 pounds (round weight)/rake-mile (see Figure 2). These included areas generally located as follows:

	General Area	Approximate Location
Area III	Grand Nord	49° 00'W 47° 10'N
Area IV	Edge of holes (strata 364)	50° 30'W 47° 25'N
Area V	Whale Bank	54° 03'W 45° 00'N
Area IV	4 miles north of Eastern Shoal	50° 30'W 46° 30'N
Area VII	10 miles south of Virgin Rocks	50° 50'W 46° 15'N

The Whale Bank area, in particular, seemed to have a widespread area of low but perhaps promising scallop concentrations. It is possible that larger concentrations might be found in small pockets across the southeastern portion of the Bank.

Iceland scallops were found widely distributed over the Grand Bank but usually in very small concentrations. In some areas there were no scallops. Tows in deeper waters in the northern portion of the bank (above 47°N) generally yielded little evidence of scallops. Large rocks, and occasional queen crabs and basket stars were the normal catch. The same type of catch was found in tows made 30 to 40 miles west of the Placentia Channel. Rocks were the common catch in the Whale Deep area, with very little other life forms.

Tows made in the southern part of the bank were almost entirely absent of scallops, but the bottom profile and fauna were quite different than in the northern part. Crabs, small clams and shells, sea stars, sea cucumbers and sand dollars were found in abundance around the northern portion of the Southeast Shoal area. Brittle stars were very common around the Tail of the Bank along with sea stars, and clam shells in some areas.

APPENDIX B

VESSELS AND GEAR

The two vessels chartered from C.W. MacLeod Fisheries Ltd. were typical wooden scallopers, (shown in cross-section in Figure 4). The vessels were constructed in the early 1960's by Smith and Rhuland, of Lunenburg, Nova Scotia, and have the following specifications:

Charlotte Louise - Overall length of 114 feet, with a beam of 23 feet, powered by a ten-cylinder Fairbanks two-cycle diesel engine which produces approx. 800 horsepower. Navigation gear aboard consisted of one Sat Nav. receiver-computer, one Decca receiver, one Loran-C receiver, one Loran-C receiver, one Loran-C computer, two Loran-C receiver-computers, two Radars, two Depth Sounders, one magnetic compass and autopilot, and Single Side Band and VHF radios.

Charlotte and Ricky - Overall length of 110 feet with a beam of 23 feet. She is powered by a six-cylinder Deutz 536 four-cycle diesel engine which produces approximately 650 horsepower. Navigation gear aboard was the same as that aboard the Charlotte Louise, with one additional magnetic compass and auto-pilot.

Both vessels are fully equipped for fishing with two offshore rakes, normally towing at a speed of approximately 4 knots, with a cruising speed of 10 knots. The rakes were 13-foot New Bedford type dredges (shown in Figure 6), of the sort normally used by the Canadian fleet.

The scallop mesh is composed of 3" steel rings interconnected by split links (Fig. 5). The number of links determines the size of the interlink space in the rake. The link configurations used during the survey are listed in Table 2. The links used on the bottom of the rake comprise that portion which is in direct contact with the sea floor during dragging. Links interconnected on the top of the rake comprise the portion between the rope-back and the club stick (see Fig. 6).

Both vessels commenced the survey towing a rake consisting of 2 links (on bottom) and 2 links (on top). The M.V. Charlotte Louise later towed a 4 link (on bottom) and 2 link (on top) arrangement because it was believed the rake needed more mesh strength to hold large boulders. Later, the M.V. Charlotte Louise decided on a 4 link and 3 link rake configuration; this arrangement is normally used in commercial fishing for giant scallops on Georges Bank.

The M.V. Charlotte and Ricky towed a 2 link (bottom and top) rake throughout the first part of the survey based on the results of the selectivity study. However, during the second trip the 4 link and 3 link configuration was used. Following the completion of the survey by the M.V. Charlotte and Ricky, selectivity tows were made to determine the percent of retention from this commercial link configuration. No attempt has been made in this report to compare or interpret the catch rates between rakes of various link configurations.

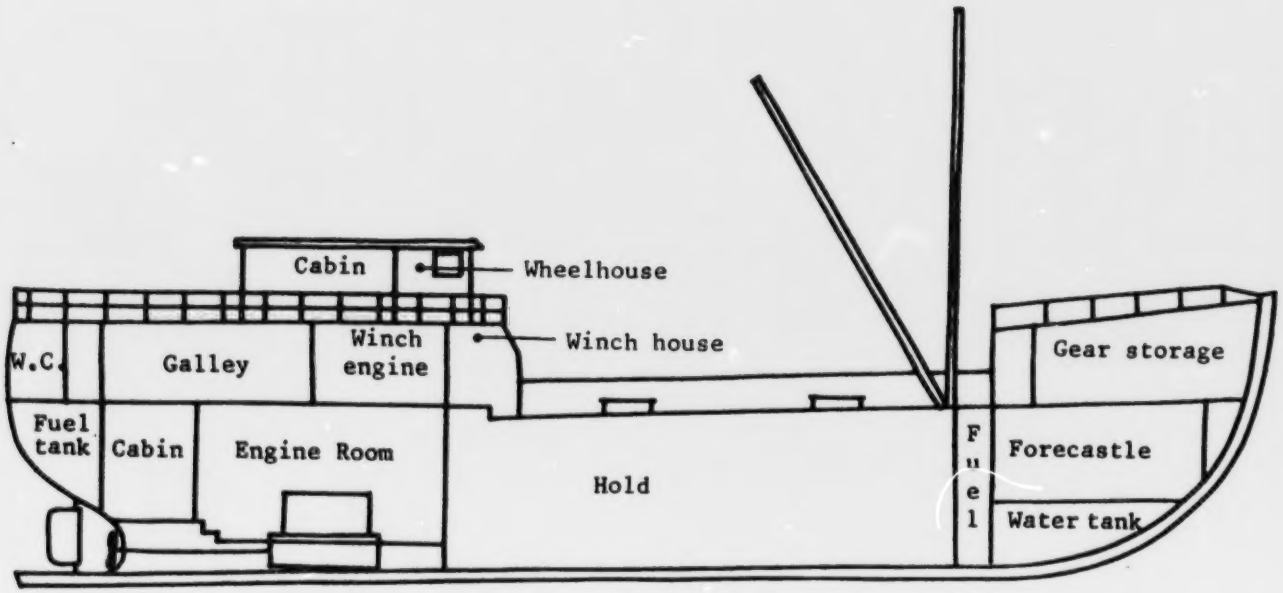


FIGURE 4

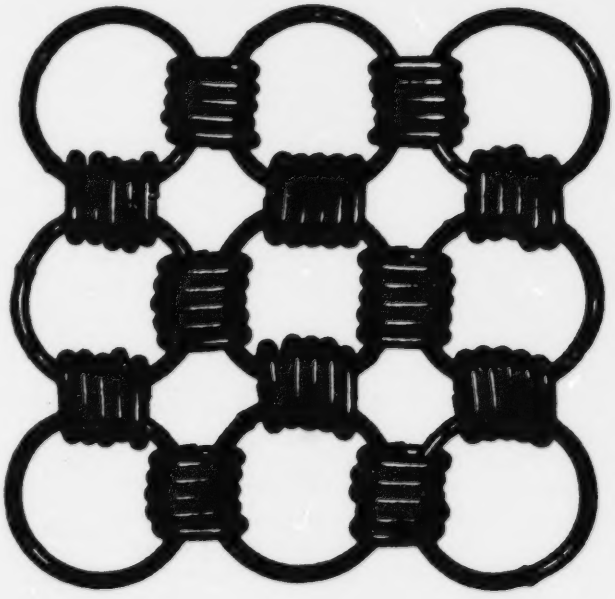
SCHEMATIC CROSS-SECTION OF A TYPICAL SCALLOP DRAGGER OF THE 110 FOOT CLASS

FIGURE 5

TWO DIFFERENT RING - LINK CONFIGURATIONS

RINGS JOINED BY
SINGLE SPLIT LINKS

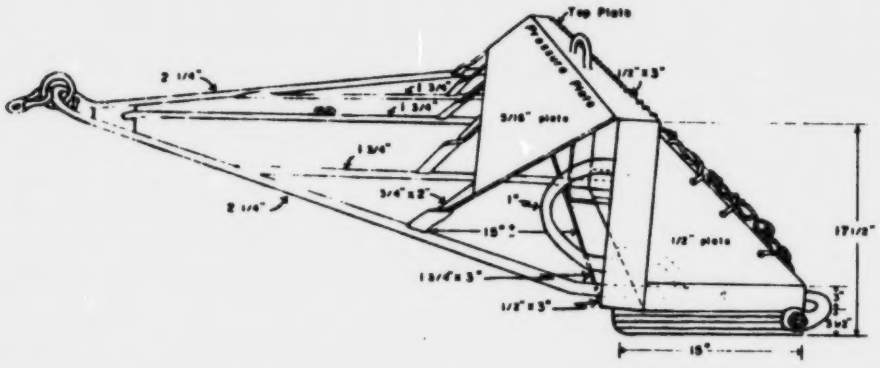
OPEN SPLIT LINKS

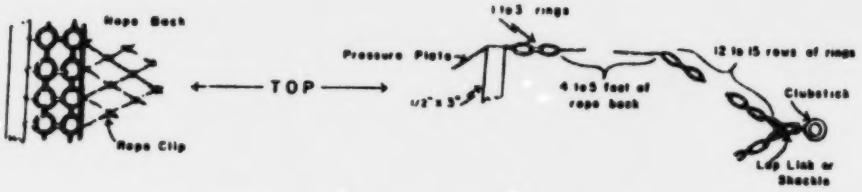


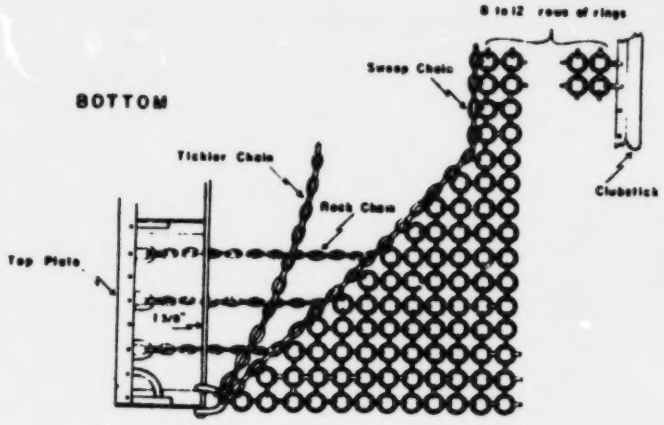
RINGS JOINED BY
FIVE SPLIT LINKS

FIGURE 6

DETAILS OF A TYPICAL OFFSHORE SCALLOP RAKE







APPENDIX C

SELECTIVITY TRIALS

In an attempt to determine the retention characteristics of the scallop rakes used in this survey, paired tows were made comparing the catches in a lined (1½" shrimp mesh) and unlined rake. Shell height measurements were made on the whole catch, keeping catches from the two rakes separate. The percent retention of the size classes represented in the unlined rake can be calculated by assuming that there is little or no escapement from the lined rake (retention = 100%).

The original plan called for comparing the percent retention of four different rake-link configurations, those interconnected with either 2, 3, 4, or 5 links. When the M.V. Charlotte and Ricky made selectivity tows on St. Pierre Bank on July 19 and 20, delays due to rough weather, and the problem in locating a suitable scallop bed resulted in only two out of four of the originally planned configurations being completed.

After successfully completing tows using 2 and 3 link rakes, it was decided that time constraints prohibited further selectivity trials on 4 and 5 link configurations.

The percent retention of the 2 link and 3 link rakes were evaluated using the following criteria:

(a) 50% retention of shell heights should approach 70mm in the unlined rake.

(b) a broad spectrum of size classes should be represented in the unlined rake.

(c) selection of larger size classes should be similar in lined and unlined rakes.

On this basis, Frank Cahill (Resource Branch, Fisheries and Oceans, St. John's) evaluated the 2 link rake as the best for fulfilling these criteria and recommended that it be used on survey tows.

However, since the 4 link rake is the commercial configuration, it was decided that in the second half of the trip selectivity trials be made on 4 links as well. These tows were made on St. Pierre Bank on Aug. 14 and Aug. 15. The results were left with Frank Cahill and Sam Naidu (Resource Branch, Fisheries and Oceans, St. John's, Newfoundland) to be used in adjusting biomass estimates.

TABLE 6

The scallop rake link configurations used by the M.V. Charlotte Louise and the M.V. Charlotte and Ricky.

Vessel Name	Dates Employed	Rake-Link Configuration Bottom *	Rake-Link Configuration Top *
M.V. Charlotte Louise	July 19	2 links	2 links
	July 19 - 22	4 links	2 links
	July 22 - 24	2 links	2 links
		4 links	2 links
	July 24 - 25	2 links	2 links
		4 links	3 links
	July 25 - Aug. 13	4 links	3 links
M.V. Charlotte and Ricky	July 21 - 28	2 links	2 links
	Aug. 2 - 16	4 links	3 links

* explained in text

APPENDIX D

TOWING INFORMATION ON THE SURVEY SETS COMPLETED
DURING THE 1982 GRAND BANKS SCALLOP SURVEY
FOR THE M.V. CHARLOTTE LOUISE
AND THE
M.V. CHARLOTTE AND RICKY

Appendix D, because of size, has been printed separately and can be obtained from the Department of Fisheries and Oceans at the address shown on the title page.

ACKNOWLEDGEMENTS

The researchers wish to express their thanks to Captains Paul Allen and Allan Skinner and to their crews for their cooperation and valuable sharing of experience throughout the duration of the cruise.

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Thanks are also due to the personnel of the Department of Fisheries and Oceans, particularly Sam Naidu, David Lemon and Gerry Brothers, and the Department of Supply and Services, especially Bill Caudle; for their understanding and concern for the problems facing the offshore scallop industry.

We also wish to acknowledge the invaluable assistance and excellent support of Mike Eaton of the Bedford Institute of Oceanography.

For the fortitude they displayed at the time of the loss of their comrade Howard March, Captain Allen and the crew of the M.V. Charlotte and Ricky have our deepest gratitude and admiration.

The writers of this report wish to thank Richard Vinson and Alan MacLean for their valuable suggestions and contributions to the report, and to the project.